PROLAB ORTHOTICS
Evidence-Based Medicine

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DIAGNOSIS, BIOMECHANICS AND ORTHOSIS TREATMENT OF KNEE OSTEOARTHRITIS

The knee is the largest joint of the lower extremity and can often become painful due to numerous pathologies. In older individuals, one of the most common pathologies which can cause pain and disability is knee osteoarthritis (OA). Knee OA often occurs in those individuals who have previously had significant meniscal or ligamentous injuries during their lifetimes. Any instability of the knee due to ligamentous tears and/or any damage to the medial or lateral meniscus can, over time, create damage to the articular cartilage of the knee which may lead to knee OA. Patients with knee OA may complain of pain, stiffness and/or swelling of the knee during standing, walking or other weightbearing activities. During clinical examination of the patient with knee OA, tenderness along the knee joint line and edema may be seen along with a lack of full knee extension, an increase in varus or valgus angulation of the knee and an antalgic gait pattern.

As knee OA progresses, there will be a gradual loss or thinning of the articular cartilage of the knee joint compartments which is one of the radiographic hallmarks of knee OA. Loss or thinning of either the medial compartment or lateral compartment knee joint cartilage due to knee OA will also increase the frontal plane angulation of the knee and tibia during weightbearing activities. A loss or thinning of the medial knee cartilage will increase the varus angulation of the knee and tibia. Loss or thinning of the lateral knee cartilage will increase the valgus knee and tibia angulation. The most common form of knee OA is medial compartment OA where the medial compartment cartilage of the tibia or femur thins and creates increased genu and tibial varum over time (Maquet, Paul GJ: *Biomechanics of the Knee.* Springer-Verlag, New York, 1984).

In the normal knee joint, without significant varus or valgus angulation, the medial and lateral knee joint compartments will share fairly equal loads and have similar intra-compartmental pressures acting on the joint cartilage. This is due to the fact that, in the knee joint with a normal knee angulation, the ground reaction force (GRF) vector acting on the plantar foot acts relatively in line with the knee joint which then creates relatively equal loading forces within both the medial and lateral knee compartments (Fig. 1). If, however, the medial compartment cartilage thins due to progression of medial knee OA, and the varus angulation of the knee increases due to loss of medial knee cartilage, there will be a medial shift of the foot relative to the knee, a medial shift in the GRF vector relative to the knee and, as a result, an increase in medial knee intra-compartmental pressures (Maquet, Paul GJ, 1984).

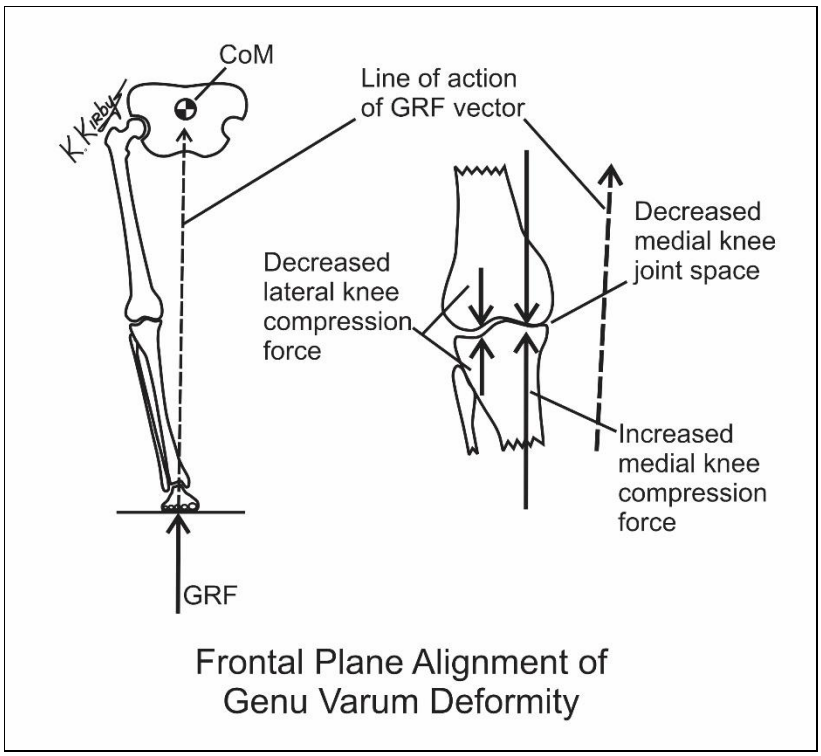

Figure 1. When the articular cartilage is thinned in the medial knee compartment, an increased genu varum deformity is created which shifts the ground reaction force (GRF) vector medially toward the center of mass (CoM) and further medially away from the knee joint. This results in increased intra-compartmental forces within the medial knee which further worsens the progression of the medial knee OA.

Alternately, if the lateral knee compartment cartilage thins over time due to progression of lateral knee compartment OA, the result will be an increase in valgus knee angulation, a lateral shift of the foot and GRF vector relative to the knee and an increase in lateral knee intra-compartmental pressures. These changes in frontal plane knee angulation can have very significant effects on the intra-compartment loading forces and pressures acting on the knee joint cartilage which can, over time, further

worsen knee OA by increasing the rate of thinning of knee joint cartilage in the affected compartment (Maquet, Paul GJ, 1984).

With this knowledge of knee biomechanics and how intra-compartmental knee pressures may be either increased or decreased by frontal plane knee angulation, the podiatrist can use this knowledge to design effective in-shoe wedges and/or custom foot orthoses to decrease the pain and disability of knee OA. If the patient has medial knee OA, an in-shoe wedge and/or custom foot orthosis with a valgus angulation will be used to shift the GRF vector more laterally on the foot to reduce the intra-compartmental pressures in the medial knee. If the patient has lateral knee OA, an in-shoe wedge or orthosis with a varus angulation will be used to shift the GRF vector medially to reduce the intra-compartment pressures within the lateral knee joint.

Frontal plane in-shoe wedging for medial and lateral knee OA have been used for at least the last 37 years for treatment of knee OA. For example, research from 1987 showed that valgus shoe insoles reduced the pain associated with medial compartment knee OA (Sasaki T, Yasuda K. Clinical evaluation of the treatment of osteoarthritic knees using a newly designed wedged insole. Clin Orthop, 215:181, 1987). Likewise, previous research from 2010 has shown that both knee biomechanics and knee symptoms significantly improve with use of valgus in-shoe wedges in treating medial knee OA (Van Raaij TM et al.: Medial knee osteoarthritis treated by insoles or braces: A randomized trial. Clin Ortho Rel Res, 468:1926-1932, 2010). My article from 9 years ago on the biomechanics of knee OA and the effective use of in-shoe wedges and custom foot orthoses for the conservative treatment of knee OA goes into much greater detail regarding the research evidence behind these subjects (Kirby KA: Can foot orthoses have an impact for knee osteoarthritis? Podiatry Today, 28(10):50-60, 2015).

Over the past 35 years of my treating both medial and lateral compartment knee OA with valgus-wedged or varus-wedged in-shoe wedges and/or custom foot orthoses, these devices have consistently been very helpful in reducing the pain and increasing the mobility of my knee OA patients. In medial knee OA, treatment starts with adhering temporary 1/8-1/4" adhesive felt valgus-wedging to the shoe insole/sockliner to determine how this wedging changes the patient's medial knee pain. Then, if successful, a 4 mm polypropylene orthosis is ordered along with a 2-3 mm lateral heel skive, a 3-5 degree everted balancing position, a flat rearfoot post, and a valgus forefoot extension to effectively shift GRF more laterally on the plantar foot and decrease the pain within the medial knee during weightbearing activities. For patients with lateral knee OA, a 4 mm polypropylene orthosis may be ordered along with a 3-4 mm medial heel skive, minimal medial arch fill, a 3-5 degree inverted balancing position, and a standard rearfoot post to effectively shift the GRF more medially on the plantar foot and decrease the patient's lateral knee pain.

In treating patients with the more common medial knee OA with valgus in-shoe wedges or custom foot orthoses, it is important to understand that even though the medial knee loading forces and medial knee pain may be reduced with valgus in-shoe wedging, the damage to the knee cartilage that originally caused the knee OA pain will not be eliminated by use of either in-shoe wedges or custom foot orthoses. As a result, valgus in-shoe wedges and custom foot orthoses generally work well in reducing the pain from mild to moderate knee OA, but not for more severe cases of knee OA. In addition, it is obvious that any valgus wedging placed inside a shoe can increase the subtalar joint (STJ) pronation moments acting on the foot which may cause undesirable pronation-related effects on the foot and ankle over time. In the treatment of lateral knee OA with varus in-shoe wedges or custom foot orthoses, the STJ will be supinated by these devices which can cause supination-related pathology over time. Therefore, the podiatrist using these frontal plane in-shoe wedges and/or custom foot orthoses in their patients with knee OA should inform their patients of the potential side effects that these devices may cause over time, but also inform their patients that these in-shoe biomechanical treatments may delay or reduce their chance of needing knee surgery in the future.

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